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BIOLOGICAL EVALUATION OF INSECT DAMAGE AT THE STUART SEED ORCHARD, KISATCHIE NATIONAL FOREST (1982)

by

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ABSTRACT

A seed orchard scouting program consisting of 9 visits was conducted during the 1982 growing season at the Stuart Seed Orchard, Pollock, Louisiana. Approximately 322 bushels of the 1982 cone crop and 1,422 bushels of the 1983 cone crop were predicted to be present in the Louisiana loblolly seed source as of October 1982. These crop estimates represent the survival of 52% of the 1982 crop from April 1981 to October 1982 and the survival of 88% of the 1983 crop from March 1982 to October 1982. Insects were the major identifiable agents causing losses to both crops. Forest Pest Management (FPM) recommends that a series of Guthion® 2S sprays applied via aircraft be continued in 1983.

INTRODUCTION

A seed orchard scouting program was initiated during 1982. This scouting program was designed to:

1) quantify the losses attributed to the major mortality agents
2) determine the periods when major mortality occurs
3) determine the effect these losses will have on the projected cone crop
4) identify areas where modification could be made to the current pest management strategy to better respond to pest pressures.

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A scouting crew from Forest Pest Management (FPM), Alexandria Field Office, monitored damage incidences and pest populations from March to October 1982. During these visits data were compiled confirming that insects are the major identifiable agents causing losses in seed orchards (Overgaard et al. 1974) and, if not controlled, insect pests will adversely affect the availability of superior pine seed, thereby reducing future timber production (Barber 1982). Because there continues to be a demand for loblolly, slash, and longleaf seed, personnel from the Kisatchie National Forest are interested in maximizing seed production. Based upon the results of these evaluations, FPM recommends that a series of Guthion® 2S sprays applied via aircraft be continued in 1983.

METHODS OF EVALUATING INSECT POPULATIONS AND LOSSES

Pest management decisions are dependent upon accurate predictions and assessments of crop production levels (I), pest population levels (II), and associated damage levels (III). Three inventory-monitoring systems were implemented to quantify this information.

I. Cone and Seed Inventory-Monitoring System (Bramlett and Godbee 1982)

A. Selection of inventory trees

Sixteen clones of the Louisiana loblolly seed source were utilized as inventory clones. In 1981, 6 clones were selected from the high production class, 6 clones from the medium production class and 4 clones from the low production class. Three ramets were sampled from each of the inventory clones. The table below lists the selected clones, the number of ramets sampled, and the number of ramets of each clone within the seed source.

Clone	Production Classes					
	High		Medium		Low	
	No. Ramets (Sampled)	No. Ramets (Orchard)	No. Ramets (Sampled)	No. Ramets (Orchard)	No. Ramets (Sampled)	No. Ramets (Orchard)
1	3	40				
5	3	47				
6	3	50				
11			3	53		
15	3	35				
16					3	39
19					3	51
22			3	46		
25					3	56
30	3	42				
34			3	51		
35					3	51
37			3	50		
42	3	50				
47			3	55		
49			3	55		
TOTAL	18	264	18	310	12	197

Within the high production class, 49% of the ramets are ramets of the clones inventoried. Within the medium production class, 44% of the ramets are ramets of the clones inventoried. Within the low production class, 18% of the ramets are ramets of the clones inventoried.

B. Inventory procedures

Prior to conelet closure in 1981, all of the female flowers within the tree crown were estimated. This number was entered on the data sheet as a total tree count. In 1982, all the female flowers within 1/2 of the tree crown were estimated. This number was doubled and entered on the data sheet as a total tree count for the 1983 cone crop.

Eight branches selected in 1981 were resampled in March, April, June, August, and October 1982, and the number of female flowers and 2nd year cones found on each tagged branch was recorded. During the first visit, new branches were selected for any missing tagged branches. If a tagged branch no longer contained any flowers or cones, the tag was removed.

II. Pest Population Inventory-Monitoring System

The Stuart Seed Orchard contains loblolly, slash, longleaf, and shortleaf seed sources. While many of the insect pests feed as generalists on several pine species, a few pests prefer only 1 particular species. The following are key insect pests causing flower, conelet, and cone damage to the Louisiana loblolly seed source.

Leptoglossus corculus (Say)	Leaffooted pine seedbug
Tetyra bipunctata (H.-S.)	Shieldbacked pine seedbug
Dioryctria merkeli Mutuura & Munroe	Loblolly pine coneworm
Dioryctria amatella (Hulst)	Southern pine coneworm
Dioryctria clarioralis (Walker)	Blister coneworm
Dioryctria disclusa Heinrich	Webbing coneworm
Family Cecidomyiidae	Cone feeding midges

Currently there are no techniques to predict population trends for any of these pests. A few techniques are available which can detect the presence of certain pests.

A. Pheromone trapping for Dioryctria spp.

Pheromone trapping techniques are available for 4 coneworm species, D. disclusa, D. clarioralis, D. merkeli, and D. amatella. Because pheromone trapping for these species is a relatively new technique, a standardized trapping scheme has not been developed. In the interim, Forest Service Research recommended using 10 Pherocon 1C® traps baited with each pheromone. Traps were hung with a pulley system from an upper limb located within the top 10 feet of the crown. Twice a week orchard personnel checked the traps and recorded the number of male moths. Baits were changed monthly.

B. Visual searches for Leptoglossus corculus and Tetyra bipunctata

Attractive trapping methods are not available for either species of seedbug commonly found in seed orchards. Beginning in late March, visual searches were made of all branches sampled during the cone and seed inventory-monitoring system. The number of seedbugs sighted was recorded.

III. Impact Inventory-Monitoring System

Data were gathered, which were used to generate impact estimates, by identifying causes of mortality for cones and conelets inventoried in the cone and seed inventory-monitoring system.

RESULTS AND DISCUSSION

Based upon the cone and seed inventory-monitoring system, approximately 322 bushels of cones were estimated to be present in the Louisiana loblolly seed source at harvest (1982). This estimate represents the survival of 52% of the original estimate made in April 1981. In addition, 1,422 bushels of cones (potential 1983 crop) are currently on the trees. This estimate represents the survival of 88% of the original estimate made in March 1982. Predictions based on a generalized survival curve indicate that approximately 1,094 bushels of Louisiana loblolly should be harvested in October 1983. Tables 1 and 2 summarize these predictions for the 1982 and 1983 crops, respectively.

The following assumptions were used to predict the size of the 1982 and 1983 cone crops.

1. Sample ramets are representative of all of the ramets of the selected clones.
2. Selected clones represent production levels of unsampled clones.
3. One bushel contains 400 cones.
4. One pound of seed can be extracted from a bushel of cones.
5. Potential estimates are based on the survival of 100% of the flowers or cones from each visit until harvest.
6. Predicted estimates are based on a generalized curve which predicts the crop size expected at maturity when mortality is considered (Bramlett 1982).

The orchard production in bushels of cones for the 1982 and 1983 cone crops are illustrated in figures 1A and 1B. The dashed lines on each graph represent the generalized curves compiled by Bramlett and Godbee (1982) for cone survival in a moderately managed orchard. The solid lines represent the actual cone survival based upon periodic observations of tagged branches.

Assessment of Key Pest Populations and Impacts

A. Coneworms

Species - *Dioryctria amatella* - southern pine coneworm
D. clarioralis - blister coneworm
D. disclusa - webbing coneworm
D. merkeli - loblolly pine coneworm

Pest Status - In the western zone of the Southern Region, greatest losses due to coneworms are attributed to *D. amatella* and *D. clarioralis*. These pests have multiple

Table 1. Estimation, based on the inventory-monitoring system, of 1982 loblolly cone crop.

Date	No. Cones	Bushels of Cones	Lbs. of Seed
April 1981			
Potential	237,304	593	593
Predicted	149,600	374	374
July 1981			
Potential	206,702	517	517
Predicted	144,800	362	362
October 1981			
Potential	192,698	482	482
Predicted	142,400	356	356
March 1982			
Potential	180,608	452	452
Predicted	134,800	337	337
April 1982			
Potential	172,713	432	432
Predicted	134,800	337	337
June 1982			
Potential	162,575	406	406
Predicted	129,600	324	324
August 1982			
Potential	142,095	355	355
Predicted	117,200	293	293
October 1982			
Potential	128,604	322	322
Predicted	128,604	322	322

Table 2. Estimation, based on the inventory-monitoring system, of 1983 loblolly cone crop.

Date	No. Cones	Bushels of Cones	Lbs. of Seed
March 1982			
Potential	643,504	1,609	1,609
Predicted	386,000	965	965
April 1982			
Potential	582,530	1,456	1,456
Predicted	354,000	885	885
June 1982			
Potential	584,635	1,462	1,462
Predicted	392,400	981	981
August 1982			
Potential	579,997	1,445	1,445
Predicted	418,400	1,046	1,046
October 1982			
Potential	568,632	1,422	1,422
Predicted	437,600	1,094	1,094

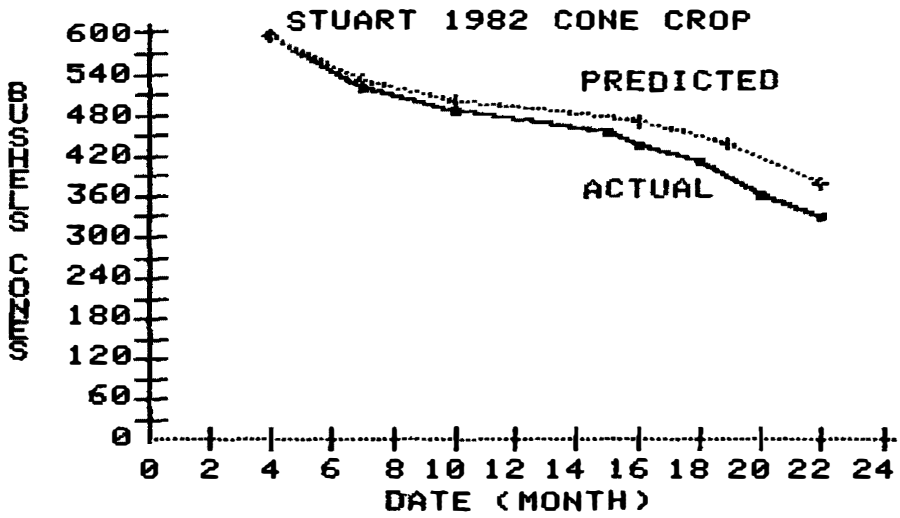

Figure 1A. Survival curve of the 1982 cone crop estimated from the cone and seed inventory-monitoring system

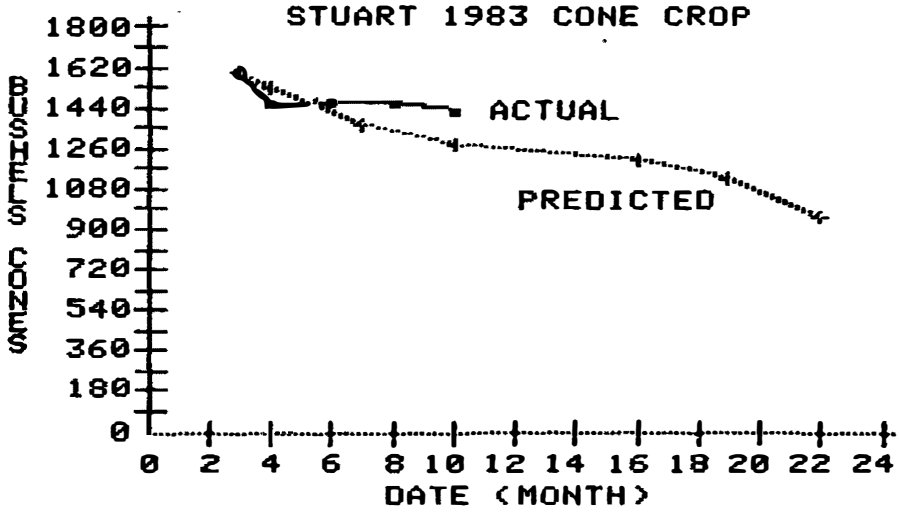

Figure 1B. Survival curve of the 1983 cone crop estimated from the cone and seed inventory-monitoring system

generations per year and, therefore, the potential exists for population buildup during the season. In certain orchards spectacular losses have been caused by D. disclusa, a single generation pest.

The pheromone trap catches (figure 2) reveal that D. disclusa and D. merkeli populations are minimal, while D. amatella and D. clarioralis populations are potentially damaging.

At the Stuart Seed Orchard, shoot attacks may be the earliest visible coneworm damage found during the spring. These attacks are usually attributed to D. merkeli, the loblolly pine coneworm, which has only one generation a year. After overwintering as small larvae, they move from shoots and flowers to cones. The larvae remain inactive throughout the summer, pupating and emerging in the fall. Currently D. merkeli does not appear to be a key pest species. Orchard personnel should be constantly alert to any unusual increase in dying tips or small dead cones which do not show any evidence of webbing.

Another species which has not reached pest status at the Stuart Seed Orchard is the webbing coneworm, D. disclusa. Trap catches during the 1982 flight were low. Therefore, it is unlikely that major losses will occur in 1983. This species overwinters as a small larva and can be found in the male catkins in the spring. If populations are large, webbing becomes very noticeable within the catkins. When the catkins are dry, the larvae migrate to the 2nd year cones, often before control programs have begun. The cones die prior to elongation, and webbing and frass are present surrounding the entry hole.

Dioryctria clarioralis, the major pest species, overwinters as a large larva and does little or no damage prior to pupating in the early spring. The first blister coneworm flight occurred from May 3 to May 20, peaking on May 13. A few D. clarioralis adults were trapped in June and August, but the second flight was not detectable. The third summer flight occurred from September 13 until harvest. Based upon the number of moths trapped during the first flight, a sizeable population evidently overwintered from the fall population of 1981. In 1982 the 2nd aerial application was applied 25 days after this first peak was detected. I suspect that this application was applied too late to decrease larval attacks. Between the May and June

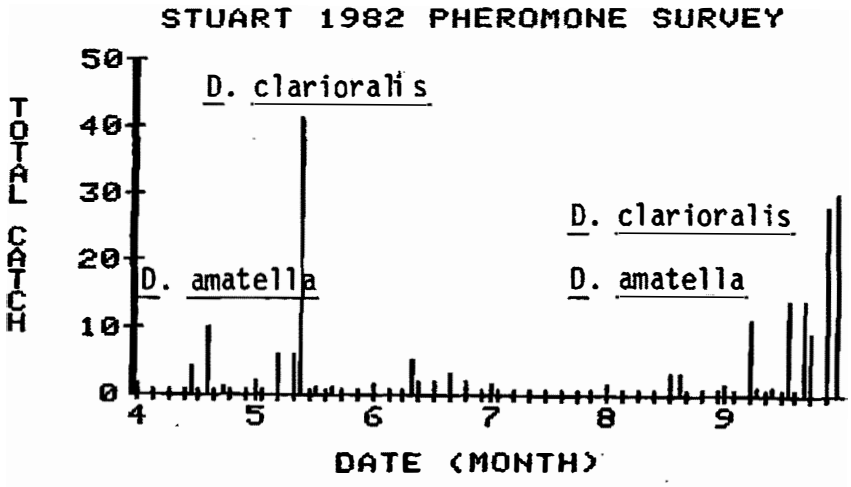

Figure 2. Frequency histogram of the pheromone trap catches of 4 coneworm species (1982)

inventories, coneworm losses on 2nd year cones increased from 1.80% to 4.24%. This increase may reflect an error in timing the 2nd spray. However, D. clarioralis populations, as detected by the pheromone traps, did not appear to build during the 2nd generation. This may be a result of trapping inefficiency during the hottest part of the summer. While a total of 55 males were trapped during the first flight, a total of 85 males were trapped during the 3rd flight. Because a late season spray was not applied at the orchard after this flight, FPM expects that D. clarioralis populations will be at damaging levels next year.

Dioryctria amatella, the southern pine coneworm, overwinters as an early instar larva and begins feeding on male and female flower buds. Later these larvae migrate to shoots or young 2nd year cones where they pupate and emerge. The early damage caused by coneworms to 2nd year cones (1.80%) detected in May probably resulted from feeding of the overwintering D. amatella larvae. The first generation moth flight was detected by the pheromone traps on April 15 to April 30 with peak catch on April 19. The 1st aerial application was applied on April 23 and if rainfall did not reduce pesticide residuals below the lethal concentration, this spray should have effectively reduced 1st generation D. amatella populations. A 2nd flight appears to have occurred between June 11 and June 20. However, trap catches were minimal. The next detectable flight occurred between September 6 and September 30. Peak catch occurred on September 6.

Coneworm damage occurred throughout the summer. The coneworm caused losses peaked between June and August (table 3). After August, damage levels declined slightly but continued above acceptable levels until harvest in October.

B. Seedbugs

Species - Leptoglossus corculus (Say) - leaffooted pine seedbug
Tetyra bipunctata (H.-S.) - shieldbacked pine seedbug

Pest Status - The sizes of seedbug populations vary widely among seed orchards. Populations of leaffooted pine seedbugs are considered to be more destructive than populations of shieldbacked pine seedbugs. Prior to June 16 only a few seedbugs had been sighted. Visual estimates are generally

Table 3. Summary of cone mortality of the 1982 Louisiana loblolly cone crop.

Mortality Agents	No. of Dead Cones		% Mortality	
March - May 1982				
Missing	941		0.52	
Unknown	2,710		1.51	
Midge	157		0.09	
Man	241		0.13	
Unknown Damage	278		0.15	
Coneworms	3,236		1.80	
D. clarioralis		120		0.07
Coneworm Damage		785		0.44
TOTAL	7,236		4.20	
May - June 1982				
Missing	440		0.25	
Man	2,143		1.24	
Tag Lost	1,196		0.69	
Unknown	1,363		0.79	
Coneworms	7,331		4.24	
Coneworm Damage		3,494		2.02
D. amatella		311		0.18
D. clarioralis		98		0.06
TOTAL	12,473		7.21	
June - August 1982				
Missing	2,151		1.33	
Unknown	2,488		1.54	
Unknown Damage	831		0.52	
Man	657		0.41	
Coneworms	15,125		9.38	
Shoot Attacks		165		0.10
Coneworm Damage		11,224		6.96
TOTAL	21,252		13.18	
August - September 1982				
Coneworms	10,232		7.20	
Coneworm Damage		4,643		3.27
Unknown	1,900		1.34	
Missing	1,059		0.75	
Unknown Damage	620		0.44	
Unknown Insect Damage	61		0.04	
TOTAL	13,872		9.77	

conservative because of the secretive behavior of seedbugs. Seedbug populations increased dramatically during the late summer. By harvest it was not unusual to find cones with several seedbugs feeding. This buildup of seedbug populations probably occurred after the last pesticide application in August. Because of the large numbers of seedbugs observed in October, the probability of large populations of overwintering seedbugs is great.

The impact seedbugs will have upon the seed crop will be covered in the post-treatment report.

It is suspected that some of the unknown and missing conelet losses (table 4) found between March and May were caused by seedbug feeding. The greatest conelet losses, 9.79%, occurred during the March to May interval. After May, conelet losses remained below 5%.

C. Other pests

No other pests were found in numbers expected to cause damage. At harvest, certain clones had significant numbers of cones with dead tips which appeared to be rotting. The cause is unknown, but often midges were present on these dying cones.

RECOMMENDATIONS

Conelet mortality in 1982 (12%) was minimal. Therefore, the 1983 Louisiana loblolly cone crop is expected to exceed 1,000 bushels. In order to realize this production goal, the 1983 pest management program must keep cone losses to a minimum. FPM recommends that the 1983 pest management strategy should consist of a series of Guthion 2S sprays (see Appendix I, Alternative 4), applied via aircraft. In 1982 this alternative resulted in good conelet protection and average cone protection. Hopefully, cone protection can be increased by making minor modifications in the application dates.

In 1982 coneworms were the key pests of 2nd year cones. Assuming that the same species causing damage in 1982 continue to cause losses in 1983, FPM recommends using the 1982 pheromone survey data to readjust application dates. Figure 3 superimposes the suggested spray application dates on the 1982 pheromone survey histogram. Based upon this information, FPM recommends a maximum of 5 sprays. The following calendar lists the approximate spray schedule.

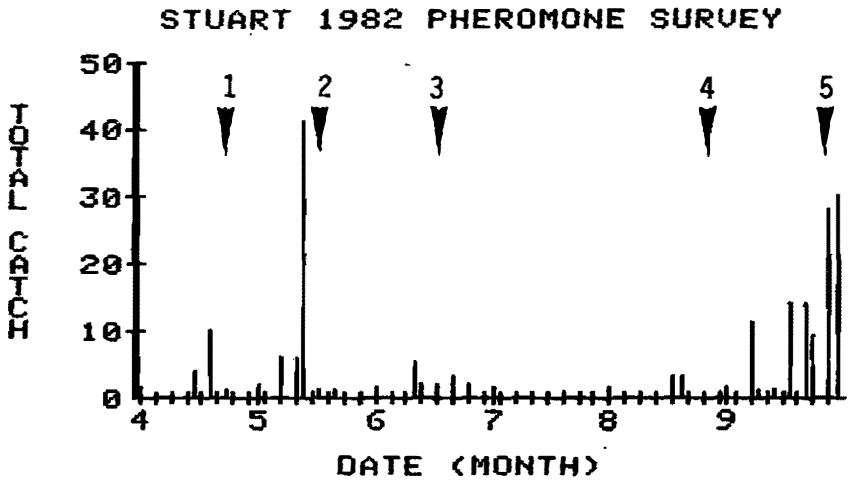

Figure 3. Frequency histogram of the pheromone trap catches with suggested application dates (◄)

Table 4. Summary of conelet mortality of the 1983 Louisiana loblolly cone crop.

Mortality Agents	No. of Dead Conelets		% Mortality	
March - May 1982				
Missing	42,949		6.67	
Unknown	10,874		1.69	
Unknown Insects	4,955		0.77	
Abortion	622		0.10	
Man	1,351		0.21	
Coneworms	2,261		0.35	
Shoot attacks		2,261		0.35
TOTAL	63,012		9.79	
May - June 1982				
Missing	2,586		0.44	
Unknown	911		0.16	
Unknown Insects	173		0.03	
Tag Lost	4,061		0.70	
TOTAL	7,731		1.33	
June - August 1982				
Missing	6,109		1.04	
Unknown	614		0.11	
Man	687		0.12	
TOTAL	7,410		1.27	
August - October 1982				
Man	4,350		0.75	
Missing	4,125		0.71	
Unknown	812		0.14	
Coneworms	732		0.13	
TOTAL	10,019		1.73	

Application	Date
1	Mid April
2	Mid May
3	*Mid June*
4	*Mid-late August*
5	Mid-late September

If pest populations are low during midsummer, the applications printed in italics could be eliminated. FPM will continue to assist seed orchard personnel in monitoring damage levels, particularly in late May and early June. If cone losses during this period are less than 5%, FPM will recommend that sprays 3 and 4 be eliminated.

FPM is recommending that Guthion 2S be applied at a rate of 2 lbs. of active ingredient per acre by aircraft. Suggested application parameters for fixed-wing and helicopter are listed below.

Parameter	Helicopter	Fixed Wing
Droplet size VMD (microns)	300-350	300-350
Nozzles	50 (D-02-25)	30 (D-06-46)
Boom Pressure (PSIG)	40	40
Speed (MPH)	25	90
Swath Width (ft.)	30	30
Release height above trees (ft.)	5	5
Adjuvant - Nalco-Trol®	3 oz/100 gal H_2O	3 oz/100 gal H_2O

Our experience has shown that many aerial applicators can apply the insecticide with a 60 ft. swath. We have no reason to suspect that an increase in swath width should adversely affect the coverage.

If the Stuart Orchard finds that Alternative 4 with aerial application does not meet their needs, FPM recommends the following alternatives in the order listed.

1) Alternative 4 - Replacing aerial with mistblower application
2) Alternative 6 - Aerial application
3) Alternative 6 - Ground application

Appendix I describes suggested control alternatives.

APPENDIX I

SEED ORCHARD PEST MANAGEMENT CONTROL ALTERNATIVES

Alternative 1. No action.

Benefits:

1) Lowers management costs
2) Encourages the natural buildup of beneficial insects and other predators
3) Reduces exposure of personnel to pesticides
4) Discourages the development of resistant strains of pests

Detriments:

1) Losses must be tolerated for indefinite periods of time
2) Pest populations may build to levels which cannot be tolerated before beneficial insects check the increase

Rationale: This alternative is usually selected when the value of the existing crop is less than the cost of the most inexpensive chemical control measure. As second generation orchards begin producing and as superior seed becomes available in storage, 1st generation orchards, or blocks within these orchards, may be placed on low maintenance. Under a low maintenance program, the "No Action" alternative will become an integral component.

Currently this option is of limited value. Young orchards which have not experienced pest population buildups are probably more efficiently managed without a structured spray program. Very few managers of producing orchards consider this a viable alternative.

Alternative 2. One Furadan® application.

Benefits:

1) Targeted at pests which feed on pine, not at beneficial insects
2) One application may reduce pest populations for several months

Detriments:

1) Furadan 10G has a high oral toxicity and must be incorporated into soil
2) High cost for a single application

3) Translocation is dependent upon adequate soil moisture
4) Efficacy decreases by midsummer
5) Application must be made in late winter or early spring when the ground is frozen or wet

Rationale: This alternative is usually considered for fairly well-drained orchards. Many orchards across the Southeast are too wet in late winter, and the application must be delayed. Applications made after mid-February will not effectively control early season pests. Apparently Furadan provides better protection of conelet crops than it does cone crops. If the flower crop is the featured crop, then a single Furadan application may be an effective strategy.

Orchard managers who have chosen this single application strategy must be willing to accept late season losses.

Alternative 3. Split Furadan application.

Benefits:

1) Targeted at pests which feed on pine, not at beneficial insects
2) One application may reduce pest populations for several months
3) Allows for flexibility in determining when Furadan will be effective

Detriments:

1) Furadan 10G has a high oral toxicity and must be incorporated into soil
2) High application and chemical cost
3) Translocation is dependent upon adequate soil moisture
4) Applications may be delayed because of ground conditions

Rationale: This alternative is usually considered in the same orchard where a single Furadan application would be effective. The treatments should be made approximately 6 weeks before the targeted pests are active or before the previous Furadan concentrations have dropped below the lethal concentration (LC). This alternative may allow you to extend the protection associated with Furadan throughout the growing season. In theory, this alternative has potential. However, the inconsistencies associated with Furadan uptake and translocation probably will make the double application even more inconsistent.

Timing is an important consideration. If the first application is targeted for early season pests. then the standard mid-February application will probably be timely for this first application. Furadan usually dissipates by mid to late summer. Therefore, a second application should be applied in late May or early June.

The 2nd important consideration is the application rate. The current label allows for application of from 4-8 oz. of Furadan 10G for each inch of tree diameter. In a split application, two 4 oz. applications should be effective if uptake is sufficient.

Preliminary results indicate that split applications of Furadan used alone do not adequately increase protection over a single application (Overgaard 1976). Additional modifications could be considered but the most important consideration is the benefit:cost of 2 applications as opposed to a single application.

Alternative 4. Three to six sprays of Guthion® or Pydrin®.

Benefits:

1) Multiple sprays allow flexibility in timing applications
2) Frequency of applications can reflect insect damages and/or population levels
3) Flexibility in method of application (ground, air)

Detriments:

1) Labor intensive
2) Excessive exposure of personnel to restricted use pesticide
3) Ground applications may be delayed by excessive soil moisture
4) Residuals from foliar applications are affected by rainfall

Rationale: This alternative allows more responsiveness to insect population levels and flexibility in targeting an application to coincide with the life cycle of the pests. Guthion and Pydrin are the only chemicals currently registered for coneworm control which can be applied monthly, throughout the summer, at the recommended rates. The most widely used formulation of Guthion is the 2S formulation. The 2S formulation does not crystalize when stored below freezing. In addition, the 2S formulation as compared with the WP formulation can be applied with less wear to spraying equipment. However, the WP formulation has a longer residual than the 2S formulation. It may be advantageous to utilize the advantages of each

formulation and use the WP formulation in spring when rainfall is heavy, switching to the less abrasive formulation in the summer and fall. Pydrin is a synthetic pyrethroid with a low mammalian toxicity. Exposure of orchard personnel to Pydrin is much less hazardous. In addition, Pydrin remains at effective concentration for longer periods than Guthion 2S.

The application schedule is extremely important. Applications should be made just prior to the periods when the greatest damages occur. The first spring application usually is made during the week following pollination. This application coincides well with the period when major conelet losses occur and when early coneworm caused losses are beginning. Subsequent sprays are often applied at monthly intervals following the initial spray. If the orchard manager has adequate information to identify and monitor the key pests, then the applications can be targeted for the susceptible stages of the key pests. Currently the technology to monitor and time sprays is limited.

Alternative 5. Furadan combined with supplementary sprays.

Benefits:

1) Insures the orchard is protected during the entire season
2) Increases the suppression efforts against coneworms
3) Early spray applications serve as a backup to Furadan if uptake is minimal

Detriments:

1) Furadan 10G has a high oral toxicity and must be incorporated into soil
2) Translocation is dependent upon adequate soil moisture
3) Application must be made in late winter or early spring when the ground is frozen or wet
4) Labor intensive
5) Ground applications may be delayed by excessive soil moisture
6) Pest management costs are increased substantially
7) Residuals from foliar applications are affected by rainfall

Rationale: This alternative is becoming increasingly popular with industrial orchards. Often the size of the area to be treated is the limiting factor.

If Furadan uptake is sufficient, conelet survival is increased substantially. The highest Furadan concentrations are usually found in the actively growing shoots, making Furadan an ideal

pesticide for early season shoot infesting pests such as tip moths. Furadan appears to be less effective against coneworms, damaging 2nd year cones. Therefore, backup sprays increase the suppression efforts targeted for coneworm control. Both pesticides are usually effective against seedbugs.

The major concern when choosing this alternative is timing the supplementary sprays to obtain maximum protection for the increased management costs. If the orchard has a history of early season pests, particularly 1st generation coneworms (Dioryctria disclusa, etc.), it may be desirable to apply a pesticide 6 days after peak pollen flight. Beginning in mid-May or early June, 2 to 4 additional sprays should protect 2nd year cones against increasing coneworm populations. If cones are harvested using the traditional hand picking procedures, the last spray would probably be applied 2 or 3 weeks before harvest. If netting is used to harvest seed, the last spray can be delayed to suppress increasing populations of both seedbugs and coneworms.

The choice of insecticides is limited. Currently 2 insecticides, Pydrin and Guthion, are registered for coneworm and seedbug control. Pydrin is an ideal chemical for spray applications during periods when orchard personnel are active within the orchard and during periods when a longer residual is needed. Therefore, spring and fall would be ideal times for Pydrin applications while Guthion might be applied in midsummer. This combination of insecticides, Furadan, Guthion, and Pydrin, should help eliminate many of the sucking insect problems associated with the use of Pydrin and Guthion applied by aerial application.

Alternative 6. Three to six sprays of mixed chemicals.

Benefits:

1) Multiple sprays allow flexibility in timing applications
2) Frequency of applications can reflect insect damages and/or population levels
3) Flexibility in method of application (ground, air)
4) Decreased potential for resistant pest populations
5) Less exposure to highly toxic chemicals

Detriments:

1) Labor intensive
2) Excessive exposure of personnel to restricted use pesticide

3) Ground application may be delayed by excessive soil moisture
4) Residuals from foliar applications are affected by rainfall

Rationale: This alternative is very similar to Alternative 4. It is usually advantageous to alternate chemicals rather than to depend on one chemical. Alternate applications of chemicals, with different modes of actions, tend to decrease the development of resistant pest populations. Currently, Pydrin and Guthion are the two registered chemicals which fit well into a spray schedule. Hydraulic, mist blower, and aerial applications of both chemicals have been demonstrated to effectively suppress coneworm and seedbug populations. The characteristics of each chemical have been described under the rationale section of Alternative 5. These characteristics should help determine when each chemical should be applied.

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PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in their original containers under lock and key out of reach of children and animals, and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear appropriate protective clothing.

If your hands become contaminated with a pesticide, wash them immediately with soap and water. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove the clothing immediately and wash skin thoroughly. After handling or spraying pesticides, do not eat or drink until you have washed with soap and water.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicide from equipment, do not use the same equipment for insecticides or fungicides that you used for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary landfill dump, or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agent, state extension specialist or FPM to be sure it is still registered for the intended use. For further information or assistance, contact Forest Pest Management, Alexandria Field Office, Pineville, La., 71360, (Telephone: FTS 497-7280, or Commercial 318/473-7280).